Gi-Fi Next Generation Wireless Technology

Pratik Tawde
Department of Electronics and Telecomunication Engineering
Vidyalanakar Polytechnic
Mumbai , India
pratik.tawde@vpt.edu.in

Samidha Chavan
Department of Information Technology
Vidyalanakar Polytechnic
Mumbai , India
samidha.chavan@vpt.edu.in

Prerana Jalgaonkar
Department of Information Technology
Vidyalanakar Polytechnic
Mumbai , India
prerana.jalgaonkar@vpt.edu.in

Kirthi Gupta
Department of Electronics and Telecomunication Engineering
Vidyalanakar Polytechnic
Mumbai , India
kirti.gupta@vpt.edu.in

Kalyani Pawar
Department of Information Technology
Vidyalanakar Polytechnic
Mumbai , India
kalyani.pawar@vpt.edu.in

Anjali Gharat
Department of Computer Engineering
Vidyalanakar Polytechnic
Mumbai , India
anjali.gharat@vpt.edu.in

Abstract:- The world of wireless telecommunications is rapidly evolving. Technologies under research and development promise to deliver more services to more users in less time. This paper presents the emerging technologies helping wireless systems grow from where we are today into our visions of the future. This paper will cover the applications and characteristics of emerging wireless technologies: Wireless Local Area Networks (WiFi-802.11n), Wireless Personal Area Networks (ZigBee) and Wireless Metropolitan Area Networks (WiMAX). The purpose of this paper is to explain the impending 802.11n standard and how it will enable WLANs to support emerging media-rich applications. The paper will also detail how 802.11n compares with existing WLAN standards and offer strategies for users considering higher-bandwidth alternatives. The emerging IEEE 802.15.4 (ZigBee) standard aims to provide low data rate wireless communications with high-precision ranging and localization, by employing UWB technologies for a low-power and low cost solution. WiMAX (Worldwide Interoperability for Microwave Access) is a standard for wireless data transmission covering a range similar to cellular phone towers. With high performance in both distance and throughput, WiMAX technology could be a boon to current Internet providers seeking to become the leader of next generation wireless Internet access. This paper also explores how these emerging technologies differ from one another.
Today's world is changing drastically. With the changing world the Wireless technology improvement has become follower in today's modern life. One of the biggest improvements made on wireless technology was inventing a new wireless technology (GI-FI). GI-FI stand for gigabit wireless fidelity, it's a wireless transmission technology; which is ten time faster than other wireless technology. Its chip delivers short-range multi-gigabit data transfer in an indoor environment. In today's world fastest transmission is must which is achieved by this GI-FI. Gigabit wireless is the world's first transceiver integrated on a single chip that operates at 60 GHz frequency band. GIFI has data transfer speed up to 5Gbps .GI-FI technology was invented by Stan Skafidis. It is manufactured using (CMOS) technology. In this paper, the brief introduction and evolution of GI-FI is explained. It also helps to know architecture and working of GI-FI. The readers will get brief knowledge about its features and advantages. The best part of GI-FI technology is its power consumption. It requires only 2watts of power for its operation with antenna 1mm. The evolution of GI-FI came into existence due to the need of higher data transfer rate ad lower power consumption.

Keywords—Bluetooth Technology,WLAN, WiFi, WiMAX, ZigBee,GI-FI

Introduction

The first thing an investor needs to determine is what is truly an emerging technology. For the investor, an emerging technology is one that offers a relatively undiscovered method to solve a daunting wireless problem in a cost-effective way. The methods or technology itself may be non-conventional, but emerging technologies that become mainstream are typically more evolutionary than revolutionary. This is because a technology cannot succeed by itself – it must bring the whole sector with it. This paper presents an overview survey of emerging wireless technologies – 802.11n, 802.15.4 and 802.16. 802.11n is a recent extension of the popular 802.11a/b/g technology known as WiFi. UWB on the other hand is standardized as IEEE 802.15.4 for low power, low-data rate applications. This technology innovation called ZigBee will make it possible to remotely monitor various types of sensors-for airconditioning, lighting, smoke alarms, and many more. "The next big thing" predicted in wireless access is the introduction of large Broadband Fixed Wireless Access cells using technologies such as WiMAX.
In effect, most of these wireless technologies will not be islands in themselves, but will offer some interconnectivity between each other. All this will just help in creating a perfectly connected environment. So just think of it-the weather, temperature and other information is being communicated by tiny sensors based on ZigBee, passing data over radio waves from one to another. At the end of the line, the data is picked up by hotspots created by WiMAX or WiFi. All these innovations are not a shot in the dark. Work is happening on most of these technologies to bring out applications so that they really help everyone stay connected. Some of the technologies are already available, while others might be available towards the end of this year or the beginning of the next year.
Melbourne University researchers have invented 5Gbps data transfer rates on a wireless chip. This is a faster than any other technology with a speed up to 5Gbps within a radius of 10 meters. . Gigabit wireless is the world's first transceiver integrated on a single chip that operates at 60 GHz frequency band. GIFI has data transfer speed up to 5Gbps. The world's first GI-FI wireless network chip where invented at Australia. WIFI and Bluetooth have capture our attention, as there is no development in wireless technology which transfer data at faster rate as video data information transfer take lots of time. It offers some advantage over Wi-Fi which is faster information rate in

Gbps, less power consumption, low cost. GI-FI is developed on integrated transceiver chip. So GI-FI is considered to be challenger to the WI-FI. GI-FI allows transfer of our favorite video information in just a second. Within five years, we expect GI-FI to be the dominant technology for wireless networking. The size of the GI-FI chip is 5×5 millimeter and can be placed in different devices such as mobile phones

Bluetooth Technology

Bluetooth technology is a wireless communications technology that is simple, secure, and everywhere. You can find it in billions of devices ranging from mobile phones and computers to medical devices and home entertainment products. It is intended to replace the cables connecting devices, while maintaining high levels of security.

The key features of Bluetooth technology are ubiquitousness, low power, and low cost. The Bluetooth Specification defines a uniform structure for a wide range of devices to connect and communicate with each other.

When two Bluetooth enabled devices connect to each other, this is called pairing. The structure and the global acceptance of Bluetooth technology means any Bluetooth enabled device, almost everywhere in the world, can connect to other Bluetooth enabled devices located in proximity to one another.

Connections between Bluetooth enabled electronic devices allow these devices to communicate wirelessly through short-range, ad hoc networks known as piconets. Piconets are established dynamically and automatically as Bluetooth enabled devices enter and leave radio proximity meaning that you can easily connect whenever and wherever it's convenient for you.

Each device in a piconet can also simultaneously communicate with up to seven other devices within that single piconet and each device can also belong to several piconets simultaneously. This means the ways in which you can connect your Bluetooth devices is almost limitless.

A fundamental strength of Bluetooth wireless technology is the ability to simultaneously handle data and voice transmissions. which provides users with a variety of innovative solutions such as hands-free headsets for voice calls, printing and fax capabilities, and synchronization for PCs and mobile phones, just to name a few.

The range of Bluetooth technology is application specific. The Core Specification mandates a minimum range of 10 meters or 30 feet, but there is no set limit and manufacturers can tune their implementations to provide the range needed to support the use cases for their solutions.

Device A ⟶ Bluetooth Version 4.2 device

Device B ⟶ Bluetooth Version 4.2 device

Table 1 :

Type of File : Image (.jpg)

File size =1.4 MB

Initial Battery Level : Device A (MI A1)= 74% and Device B (Micromax)= 55%

Sr.No	Distance (Feet)	Time required for transmission from Device A → Device B (secs)	Battery Level	
			Device A (MI A1)	Device B (Micromax)
1	5	25	85	57
2	10	24	85	57
3	15	24	85	57
4	20	24	85	56
5	50	30	85	56
6	120	50	84	56

Table 2 :

Type of File : Audio

File size =1.2MB

Initial Battery Level : Device A (MI A1)=83% and Device B (Micromax)= 55%

Sr.No	Distance (Feet)	Time required for transmission from Device A → Device B (secs)	Battery Level	
			Device A (MI A1)	Device B (Micromax)
1	5	23	83	55
2	10	25	83	55
3	15	27	83	55
4	20	28	83	54
5	50	46	82	54
6	120	80	82	54

Table 3 :

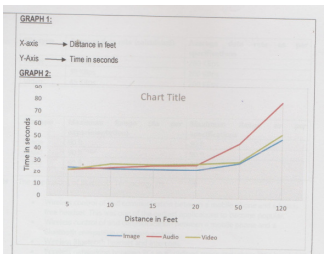
Type of File : Video

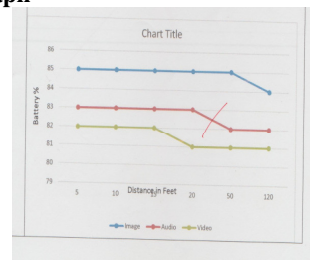
File size = 1.34MB

Initial Battery Level : Device A (Moto G4+)= 59% and Device B (LG K10)= 40%

Sr.No	Distance (Feet)	Time required for transmission from Device A → DeviceB (secs)	Battery Level	
			Device A (MI A1)	Device B (Micromax)
1	5	23	82	53
2	10	28	82	53
3	15	28	82	53
4	20	29	81	53
5	50	31	81	53
6	120	54	81	53

Graph





Results

File type	Average data rate (calculated)	Average data rate as per specifications
Image	51 KBps	260 KBps
Audio	39 KBps	260 KBps
Video	45 KBps	260 KBps

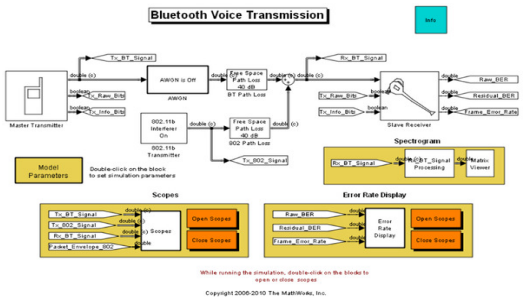
File type	Maximum Range (As per experimentation)	Maximum Range as per specifications
Image	90 ft	90 ft
Audio	90 ft	90 ft
Video	90 ft	90 ft

Applicaions of Bluetooth Technology

1.Wireless control of and communication between a mobile phone and a hands free headset. This was one of the earliest applications to become popular.
2.Wireless control of and communication between a mobile phone and a Bluetooth compatible car stereo system
3.Wireless Bluetooth headset and Intercom.
4.Wireless networking between PCs in a confined space and where little bandwidth is required.
5.Wireless communication with PC input and output devices, the most common being the mouse, keyboard and printer.
6.Transfer of files, contact details, calendar appointments, and reminders between devices with OBEX.

Bluetooth is a short-range radio link technology that operates in the 2.4 GHz Industrial, Scientific, and Medical (ISM) band. The demo modulates the signal using Gaussian frequency shift keying (GFSK) over a radio channel with maximum capacity of 1 Mbps.

MATLAB & Simulink Block Diagram for Bluetooth voice Transmission

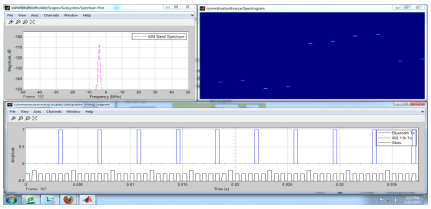


This demo models part of a Bluetooth® system. The demo uses frequency hopping over a 79 MHz frequency range to avoid interference with other devices transmitting in the band. In this scheme, the sender divides transmission time into 625-microsecond slots, and uses a new hop frequency for each slot. Although the data rate is only 1 Mbps, a much larger bandwidth of 79 MHz is required to simulate the frequency hopping effects.The Bluetooth model contains the following elements:

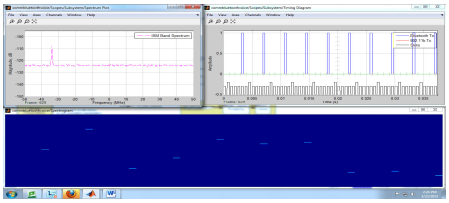
Master transmitter
Radio channel
IEEE® 802.11b interferer
Slave receiver
Bit error rate (BER) display
Scopes
The transmitter subsystem performs speech coding, buffering, framing, header error control (HEC), forward error correction (FEC), GFSK modulation, and frequency hopping. Channel effects modeled include thermal noise, path loss, and interference. The Free Space Path Loss block, from the RF Impairments library, models path loss. The IEEE 802.11b interferer is a masked subsystem that opens up a mask dialog for user input on double-clicks. Mean packet rate, packet length, power, and frequency location in the ISM band can be specified in the dialog. The Slave Receiver recovers speech from the transmitted signal, performing all the complementary operations that the transmitter does, but in reverse order.

SIMULATION RESULTS AND GRAPHS:

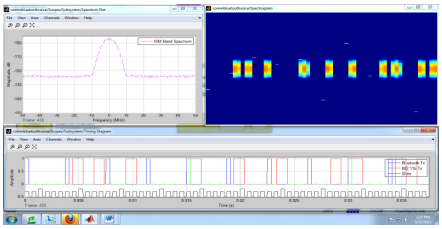
CASE 1: AWGN off and 802.11 off



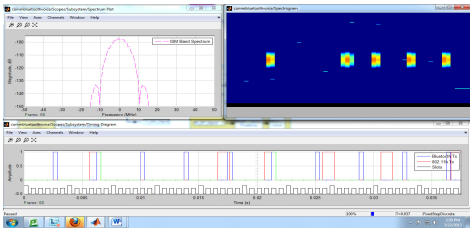
CASE 2: AWGN on and 802.11 off



CASE 3: AWGN on and 802.11 on



CASE 4: AWGN off and 802.11 on



Effect of AWGN and of Interference of 802.11b on transmission.

CASE 1: AWGN off and 802.11 off

In this case, as shown in the graph , there are no interferer slots because WLAN interferer is off.

CASE 2: AWGN on and 802.11 off

In this case, as shown in the graph , there are no interferer slots because WLAN interferer is off.

CASE 3: AWGN on and 802.11 on

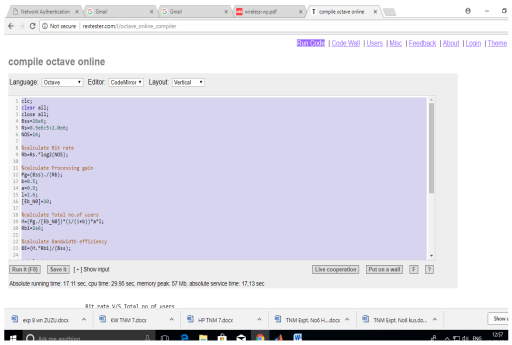
In this case, as shown in the graph , , there are maximum interferer slots because WLAN interferer and AWGN is on.

CASE 4: AWGN off and 802.11 on

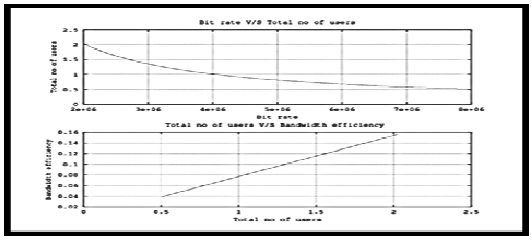
In this case, as shown in the graph , , there will be little interferer slots because WLAN interferer is on and AWGN is off.

Calculation and ploting of the number of users and bandwidth efficiency of WLAN system

A QPSK/DSSS WLAN is designed to transmit in 902-928MHz ISM band. The symbol transmission rate is 0.5 Megasymbols/sec. An orthogonal code with 16 symbols is used. E_b/N_o = 10 dB
A sector antenna with a gain of 2.6 is used. Assume interference factor β=0.5 to account for interference from users in other cells and power control efficiency α = 0

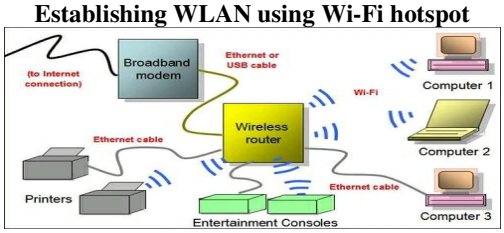


Code in Octave Screenshot:



The bitrate depends on the symbol rate. As bit rate increases, the processing gain decreases and thus, the number of users decreases. For a constant processing gain, as the number of users increases the bandwidth efficiency of the system increases.

Establishing WLAN using Wi-Fi hotspot



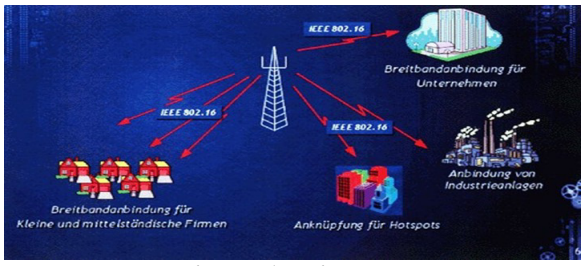
Procedure:

1. Select the wireless devices that need to be connected in WLAN through WiFi hotspot (minimum 2 & maximum 6, devices).
2. Select anyone of the device that is desired to be the Access Point AP.
3. Configure the AP as follows :
   Switch ON the mobile data connection from the AP.
   (Menu>>Settings>>Wireless & Networks>>Mobile Networks>>Data Enable.)
   Select from home-screen Menu>>Settings>> Wireless & Networks>>Tethering & Portable Hotspot>>Enable Portable Hotspot.
   After enabling hotspot, from the same menu select configure WiFi hotspot.
   Enter details :
   Network name (Router SSID): M.E ExTc
   Security : WPA2-PSK
   Password: 12345678
   Save the above settings.
   AP is successfully configured & ready.
   Configuration of wireless terminals (user devices):
   a. Menu>>Settings>>Wireless & Networks>>Switch ON WiFi>>Open WiFi settings.
   b. Scan for the available WiFi networks.
   c. Select the network "M.E ExTc">>Connect.
   d. Enter password for authentication.
   e. Connection is successfully configured.
   f. Open browser to access internet.
   Similarly, up to 5 devices can be supported to a given AP depending upon capacity of AP.

Comparison of Bluetooth and Wi-Fi

Characteristic	Bluetooth	Wi-Fi
Frequency	2.4 GHz	2.4 GHz
Range	10 meters	100 meters
Primary application	WPAN: cable replacement	WLAN: Ethernet
Data transfer rate	800 Kbps	11 Mbps
Power consumption	Low	Medium
Primary devices	Mobile phones, PDAs, consumer electronics, office and industrial automation devices	Notebook computers, desktop computers, servers
Primary users	Traveling employees; electronics consumers; office and industrial workers	Corporate campus users
Usage location	Anywhere at least two Bluetooth devices exist — ideal for roaming outside buildings	Within range of WLAN infrastructure, usually inside a building
Development start date	1998	1990
Specifications authority	Bluetooth SIG	IEEE, WECA

Wi-Max



Wi-Max Architecture

(WORLDWIDE INTEROPERABILITY FOR MICROWAVE ACCESS) – 802.16 Yet another wireless network technology may have an impact over the next few years: 802.16, better known as WiMAX. The IEEE approved the 802.16 standards in June 2004 This technology supports speeds as high as 70Mbps and a range of up to 48 kilometers. WiMAX can be used for wireless networking like the popular WiFi. WiMAX allows higher data rates over longer distances, efficient use of bandwidth, and avoids interference almost to a minimum. WiMAX can be termed partially a successor to the Wi-Fi protocol. Current technologists envision a WiMAX receiver in a person's home, with a WiFi transmitter to serve in-home connections, and longer term having laptops and personal devices capable of transmitting directly to WiMAX towers.

WiMAX also makes ubiquitous Internet access possible. WiMAX, operating at comparable distances as cellular phones, can be installed on cellular towers and allow Internet data access in as many places as cellular phone access. This adds a new dimension to what Internet access providers can offer: a broadband connection that a person can take with them when they travel. WiMAX Forum was formed in April 2001, to promote conformance and interoperability of the standard IEEE 802.16. The forum was formed solely for development & promotion of devices supported by the 802.16 standard. In September 2004, Intel introduced initial samples of a WiMAX chipset, named Rosedale. Intel has plans to ship WiMAX devices for use in the office and home by 2007. The IEEE 802.16 standard is versatile enough to accommodate time division multiplexing (TDM) or frequency division duplexing (FDD) deployments and also allows for both full and half-duplex terminals. WiMAX uses microwave radio technology to connect computers to the Internet. WiMAX works very much like cell phone technology in that reasonable proximity to a base station is required to establish a data link to the Internet. Users within 3 to 5 miles of the base station will be able to establish a link using non line- of-sight (NLOS) technology with data rates as high as 75Mbps. Users up to 30 miles away from the base station with an antenna mounted for line-of-sight (LOS) to the base station will be able to connect at data rates approaching 280Mbps.

Characteristics of WiMAX

Technical aspects of 802.16a that are instrumental in powering robust performance include following characteristics:

- Power: Varies with band. Profiles from 100 Mw up to 2W
- Configuration: P-P and P-MP Cellular
- Spectrum: Initially 3.5 GHz licensed and 5.8 GHz unlicensed bands
- Radio interface: OFDM, using 256 tones
- Access Protocols: Downstream - TDM (Broadcast), Upstream - TDMA with access contention
- Security via station authentication and encryption
- Data rates variable with channel bandwidth 3.5 MHz in 3.5 GHz band, 20 MHz in 5.8 GHz band
- Actual realizable data rates are ~ 2b/Hz
- Maximum range ~2Km for indoor Non-LOS cellular service at 3.5 GHz

Applications of WiMAX

WiMAX will allow people to go from their homes to their cars, and then travel to their offices or anywhere in the world, all seamlessly. WiMAX can serve the business, residential and mobile segments. The applications in these areas are listed below:

Residential users

•Basic voice services, low cost domestic & international calls •Basic (dialup speed) to advanced (over 1Mbps) data connections

•Bundled voice and data services Business users

- Basic data connectivity for small businesses
- Advanced data services to medium and large businesses
- Feature-rich, low cost voice services (VoIP) Mobile users (mobile WiMAX only)
- Data connectivity for mobile workforce
- Data connectivity for international visitors

ZIGBEE – 802.15.4

ZigBee is one of the newest technologies enabling Wireless Personal Area Networks (WPAN). ZigBee is the name of a specification for a suite of high level communication protocols using small, low-power digital radios based on the IEEE 802.15.4 standard. The technology is intended to be simpler and cheaper than other WPANs such as Bluetooth. ZigBee protocols are intended for use in embedded applications requiring low data rates and low power consumption. Though WPAN implies a reach of only a few meters, 30 feet in the case of ZigBee, the network will have several layers, so designed as to enable intrapersonal communication within the network, connection to a network of higher level and ultimately an uplink to the Web.

Importance of Zigbee

There are a multitude of standards that address mid to high data rates for voice, PC LANs, video, etc. However, up till now there hasn't been a wireless network standard that meets the unique needs of sensors and control devices. Sensors and controls don't need high bandwidth but they do need low latency and very low energy consumption for long battery lives and for large device arrays. There are a multitude of proprietary wireless systems manufactured today to solve a multitude of problems that also don't require high data rates but do require low cost and very low current drain. The ZigBee Alliance is not pushing a technology; rather it is providing a standardized base set of solutions for sensor and control systems. To allow vendors to supply the lowest possible cost devices the IEEE standard defines two types of devices: full function devices (FFD) and reduced function devices (RFD).An IEEE 802.15.4/ZigBee network requires at least one full function device as a network coordinator, but endpoint devices may be reduced functionality devices to reduce system cost.

Characteristics of ZigBee

ZigBee is poised to become the global control/sensor network standard. It has been designed to provide the following features:

Low power consumption, with battery life ranging from months to years.

2) Maximum data rates allowed for each of the frequency bands are fixed as 250 kbps @2.4 GHz, 40 kbps @ 915 MHz, and 20 kbps @868 MHz.

3) High throughput and low latency for low duty-cycle applications

4)Channel access using Carrier Sense Multiple Access with Collision Avoidance (CSMA - CA).

5)Addressing space of up to 64 bit IEEE address devices, 65,535 networks.

6)70-100m range.

7) Low cost (device, installation, maintenance). Low cost to the users means low device cost, low installation cost and low maintenance. ZigBee devices allow batteries to last up to years using primary cells (low cost) without any chargers (low cost and easy installation). ZigBee's simplicity allows for inherent configuration and redundancy of network devices provides low maintenance.

8)High density of nodes per network: ZigBee's use of the IEEE 802.15.4 PHY and MAC allows networks to handle any number of

devices. This attribute is critical for massive sensor arrays and control networks.
9) Fully reliable "hand-shaked" data transfer protocol.
10) Different topologies like: star, peer-to-peer, mesh

Applications of ZigBee

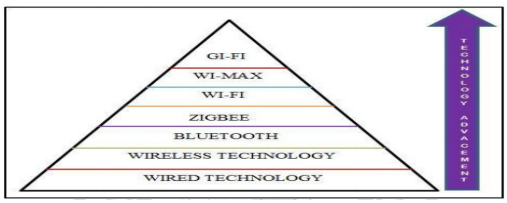
ZigBee networks consist of multiple traffic types with their own unique characteristics, including periodic data, intermittent data, and repetitive low latency data. The characteristics of each are as follows:
1)Periodic data – usually defined by the application such as a wireless sensor or meter. Data typically is handled using a beaconing system whereby the sensor wakes up at a set time and checks for the beacon, exchanges data, and goes to sleep.
2) Intermittent data – either application or external stimulus defined such as a wireless light switch. Data can be handled in a beaconless system or disconnected. In disconnected operation, the device will only attach to the network when communications is required, saving significant energy.
3) Repetitive low latency data – uses time slot allocations such as a security system. These applications may use the guaranteed time slot (GTS) capability. GTS is a method of QoS that allows each device a specific duration of time as defined by the PAN coordinator in the Superframe to do whatever it requires without contention or latency.

GIFI IS BEST TECHNOLOGY

There are lots of reasons to use GI-FI instead of other wireless technology, these are as given below:
A)In GI-FI technology chip is used which is work on 50GHz frequency and of speed of 5Gbps which is much greater than recently used wireless technology such as WI-FI and Bluetooth.
B) In GIFI mixing and signal filtering is used. Which would keep the signal strong versus the large range, but in slower speed as WIFI
C) The GIFI uses the short-range wireless technology would potentially be a competitor or more Than likely a replacement for WIFI, and things like Bluetooth might want to look out as well.
D) GIFI technology consume less power as compared to WIFI and Bluetooth
E) The reason for pushing into GIFI technology is because of slow rate, high power consumption, low range of frequency operations of earlier technologies i.e. Bluetooth and Wi-Fi. See the comparisons and features of those two technologies.

Characteristics of Gi-Fi Technology

Data Transfer Rate: 5Gbps
Range: 10meter
Specification authority: NICTA
Development start date: 2004
Power consumption: 2MW
Frequency: 57-64GHz
Primary device: Mobile phones, Home Devices, PDAs, Consumer, Electronics Office Industrial automation Devices



Network Evolution

COMPARISON OF EMERGING WIRELESS TECHNOLOGIES

Technology	WiFi - 802.11n	ZigBee	WiMAX
Application	Wireless LAN, Internet	Sensor Networks	Metro Area Broadband Internet connectivity
Typical Range	100m	70-100m	50 km
Frequency Range	2.4 GHz	2.4GHz	2-11GHz
Data Rate	108 - 600Mbps	250Kbps	75Mbps
Modulation	DSSS	DSSS	QAM
Network	IP & P2P	Mesh	IP
IT Network Connectivity	Yes	No	Yes
Network Topology	Infrastructure (Ad-hoc also possible)	Ad-hoc	Infrastructure
Access Protocol	CSMA/CA	CSMA/CA	Request/Grant
Key Attributes	Wider Bandwidth, Flexibility	Cost, Power	Throughput, Coverage

CONCLUSION

This paper has presented an overview of emerging wireless technologies. 802.11n is viewed as the most likely contender for the home network backbone. ZigBee, on the other hand, is likely to make best use of its low-power and high-speed operation in short-range equipment interconnects, such as personal computers and portable equipment. ZigBee networks are primarily intended for low duty cycle sensor networks. 802.11n is viewed as being superior in maintaining compatibility with existing wireless LAN, while ZigBee is generally thought more likely to achieve lower levels of power consumption. Our vision of the future is that WiMAX will enable mobile broadband at an affordable price. This will be achieved through the adoption of WiMAX by a cellular provider seeking to make a jump to this disruptive technology. WiMAX is not expected to completely eliminate the Wi-Fi technology in the near future, but will be a complement to WiFi as its primary backhaul service of choice. WiMAX promises to help corporations expand business, drive down costs, increase overall profitability, increase the quality of service, and increase the number of users that connect to the Internet. Thus the wireless transmission of information at very fast speed is achieved. GI-FI allows wireless transfer of audio- video data up to 5Gbps, ten times the current maximum wireless transfer rate, at one-tenth of the cost, usually within a range of 10 meters that operates at 60GHz on the CMOS process, Some other benefits such as no frequency interference, Low power consumption and high security make it suitable to replace existing wireless technologies for the implementation in different transmission systems. As now GI-FI has been a developing technology on which still an advanced research is going on its application

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